

# MOLECULAR SIEVES BASED NANO-COMPOSITE UV-RESISTANT MATERIAL, PREPARATION PROCESS AND USE THEREOF

## FIELD OF THE INVENTION

The present invention relates to the preparation of UV-resistant materials. More particularly, the present invention ~~material, in particular, it~~ relates to an UV-resistant materials ~~material~~ which is comprise ~~made with~~ crystalline porous materials ~~material~~ such as zeolite molecular sieve sieves and mesoporous molecular sieve ~~being~~ sieves that support the host and the nano-cluster nano-clusters of  $\text{TiO}_2$ ,  $\text{ZnO}$ ,  $\text{CeO}_2$ , and  $\text{Fe}_2\text{O}_3$ . ~~being the guest,~~ The present invention also further relates to the preparation methods and uses of the UV-resistant materials. ~~method and the use thereof.~~

## BACKGROUND OF THE INVENTION

~~By reason~~ As a result of the development of modern industry, the atmospheric pollution is getting worse ~~worsening~~ and the damage level of the ozonesphere ~~ozonsphera~~ is seriously increasing ~~serious-increasingly~~ in recent years. It is an imminent problem to resist the ultraviolet radiation in quite a number of the fields. The hazard of excess UV is mainly incarnated in the following aspects:

1: The peptide ~~chain~~ chains of the protein will be damaged when an organism is exposed to uv irradiation, resulting ~~irradiate on the organism, which~~ result in the production ~~produce~~ of free radicals. ~~radicles.~~ The free radicals

radicals will further react ~~act~~ with other peptide chains and eventually result in tissue damage and gene mutation. For a human body, it will result in skin burn injury and the production ~~produce~~ of skin cancer. Using sun-prevent cosmetics is one of the efficient ways to prevent these ~~resolve the above~~ problems.

2: The ultraviolet light ~~ultravioletlight is as a~~ high energy wavelength ray which leads ~~will lead to~~ molecular ~~molecule~~ industrial product aging and shortening the lives of products. ~~lifeshortening.~~ Therefore, in general, UV-resistant agents are added to high molecular ~~molecule~~ products. ~~will be added with UV-resistant agent.~~

In some countries, such as the United States, Japan and Europe, the research and the use of sun-prevent cosmetics ~~cosmetic~~ have reached a high level and sun-preventative ~~sun-prevent~~ cosmetics have become a key focus point of the ~~developing~~ development of cosmetics ~~cosmetic~~ for skincare. The annual growth rate of sun-preventative ~~sun-prevent~~ cosmetics is 5-10% in Europe. It has been reported that the yield of sun-preventative ~~sun-prevent~~ cosmetics accounted for a half of the inventory of the cosmetics in 1990 in the United States. In China, ~~our country~~, with the rapid progress of the living standard, and enhancement of people's consciousness of aesthetics and health care, many people are paying more attention to UV protection. The increasing growth rate of the sun-preventative ~~sun-prevent~~ product market in China has remained ~~our countries is kept~~ above 20% from the 1990s. ~~metaphase.~~ Moreover, UV-resistant agents ~~are agent~~ is also used more and more. ~~used.~~ In the plastic materials and ~~material~~, rubber industries, and ~~paint industry~~, especially ~~in in the~~ paint industry, highly active and steady UV-resistant agents have always been a key point of research and development. ~~R&D.~~

~~The~~ At present, developed UV-resistant materials include two main classes of chemical and physical, with the ~~at present~~. The use of the former is being more popular. ~~The chemical~~ Chemical UV-resistant agents in general are organic ~~compounds, therefore~~ compounds. Therefore, they have good compatible, but they also generally have certain toxicity and irritancy to the skin. They are not compatible consistent with the ~~healthy~~ current health concerns of people, ~~at the present~~, because it is easy to cause anaphylaxis when they are used in the products which come in direct contact with the skin, ~~directly~~. In addition, the organo-UV-resistant agents always have bad photostability and they will decompose or become oxidized when exposed to UV radiation, ~~be decomposed or oxidised under uviolize~~. The development of nanotechnology ~~nanometer~~ techniques allows for solutions for resolving the above problems. ~~They~~ There are physical UV-resistant agents developed with nanotechnology, ~~nanometer~~ techniques, ~~i.e. the~~ e.g., abio-nanometer UV-resistant agents. Abio-nanometer UV-resistant agents have characteristics of stabilization and broad-spectrum resistance which ~~broad-spectrum~~, they make up for the disadvantages of the organo-UV-resistant agents to a certain degree. ~~With the application, the~~ The shortcomings of abio-Nanometer UV-resistant agents have been increasingly apparent as applications have been developed, ~~come out increasingly~~. The surface activity is the most typical shortcoming, ~~typically~~. ~~By reason~~ Beacuse of the high surface energy of the abio-Nanometer particles, when they are mixed with ~~the~~ an organic phase, coacervation easily occurs and results ~~it is easy to occur coacervation and resulting~~ in the inactivation ~~inactivating~~ of the UV-resistant agents. In addition, ~~Together, the~~ security is also one of the potential problems encountered in ~~of~~ the application of the nanometer particles.

For instance, nano-ZnO and nano-TiO<sub>2</sub> have photocatalytic photocatalysis reactiveness and will produce free ~~radicles~~ radicals when exposed to under daylight, ~~it will do~~ resulting in harm to human DNA, ~~of human body~~. John Kownland et al. of Oxford have researched the negative effects ~~effect~~ of and ZnO extensively. ~~deeply~~. It is stated that TiO<sub>2</sub> and ZnO produce oxygen and oxyhydrogen free radicals ~~radicles~~ in photoillumination. ~~Different from the knowledge of the people,~~ Contrary to prior belief, ~~it has been proven~~ is proved that it is oxyhydrogen free radicals that ~~radicles do~~ harm to human DNA, ~~of the human body~~, while oxygen radicals do not. Therefore, the method of adding oxygen radical scavenging agent agents to ~~proof the~~ prevent harm caused by of TiO<sub>2</sub> and ZnO is not enough. ~~The nano-cluster assembling~~ Nano-cluster assemblies with molecular sieve sieves being the host or supports can resolve the above problem drastically.

~~Molecular~~ A molecular sieve is a kind of crystalline and porous material. Its porous channels have a ~~channel has~~ characteristic of narrow distribution of pore size and high-ordered microstructure, ~~in microcosmic~~. Using the porous channel structure of a molecular sieve as a ~~template,~~ template and assembling the guest molecules ~~molecule~~ into the porous channels results in a ~~channel,~~ high ordered nano-cluster arrangement, ~~can be obtained~~. The assembling technique can not only ensure the dispersion ~~disperseion~~ of the nano-cluster, but can also enhance the performance of the nano-cluster to a large extent. Many assembling methods have been developed in this field. In researching the assembling methods of semiconductor-guest, coordination compound-guest and some macromolecule organo-guest, a kind of technique known as “ship in bottom” has been developed. In short, this method ~~is to introduce~~ introduces the guest monomer micromolecules ~~micromolecule~~ into the porous channels ~~channel~~ of the molecular sieve, then

~~initiates initiate~~ the condition of synthetic reaction in ~~the porous channels channel~~ to occur ~~causing a the~~ combination reaction. ~~To use~~ Using an in situ synthetic method ~~in-situ~~ sometimes ~~has goodish~~ provides a good effect when assembling some nitrogen-containing or nitrogen-based organo-guests. ~~nitrogencontaining based-organoguest~~. The composite materials obtained ~~from~~ by the above ~~methods method~~ behave as macro granulometric ~~patterns pattern~~ professedly yet have nano-cluster characteristics, ~~virtually~~. Furthermore, ~~By reason~~ because of the template action of the porous ~~channels channel~~ of the molecular sieve, the ~~guests guest~~ behave as in an ordered microscopic microcosmic height. As a result, ~~It let~~ the material properties can be changed by an ~~occur changes of~~ order of magnitude, ~~to a large extent~~.

This type of assembling methods appears particularly suitable high application ~~merit in~~ sun-preventative ~~sun-prevent~~ cosmetics, coatings, rubber and plastics ~~industries. industry~~. Whether using the conventional organo-ultraviolet absorption ~~material, materials~~ or the new style abio-ultraviolet ~~abio-ultraviolet~~ absorption ~~materials, material, they can place~~ the technical group of these materials can be placed into the porous ~~channels channel~~ of the molecular sieve to avoid the coacervation of nanometer ~~particles, and this~~ particles. This technical solution can also ~~farthest~~ reduce the side-effect of the ultraviolet absorption agent. It is more important that the performance of ultraviolet absorption can be extremely enhanced ~~extremely~~ by reason of the high ordered microscopic microcosmic state of the ultraviolet absorption agent.

One object of the present invention is to provide ~~a kind of~~ UV-resistant ~~materials. material~~.

Another object of the present invention is to provide ~~the method of~~

~~preparation of said methods for preparing the UV-resistant materials. material.~~

Another object of the present invention is to provide uses for the ~~use of said~~ UV-resistant materials. material.

The description of the invention

The present invention provides a UV-resistant materials ~~material~~ which use molecular sieve based host-guest nano-composite materials as the ultraviolet absorption agents. agent. The host is selected from one or more than one material of micro- and mesoporous molecular sieve-type materials ~~sieves-types,~~ such as X, Y, A, STI, ZSM-5, MCM-41 and the series thereof, and SBA and the series thereof, ~~the thereof.~~ The guest-cluster is selected from one or more than one material of  $\text{TiO}_2$ ,  $\text{ZnO}$ ,  $\text{CeO}_2$ , and  $\text{Fe}_2\text{O}_3$ . This kind Of UV-resistant material uses ~~use~~ the microscopic ~~microcosmic~~ ordered porous channels ~~channel~~ of the molecular sieve as a template. The guest-cluster is directional ~~directionally~~ with high-order by the quantum confinement effect. ~~The~~ In the nano-cluster it can be ensured that only the interval plane of the nano-clusters exist ~~steadily, but also~~ steadily. In addition, the performance is improved greatly.

The present invention also provides two preparation methods of the UV-resistant material.

The first preparation method uses any one or more than one material of  $\text{TiCl}_3$ ,  $\text{Ti}(\text{NO}_3)_3$ ,  $\text{ZnCl}_2$ ,  $\text{Zn}(\text{NO}_3)_2$ ,  $\text{CeCl}_3$ ,  $\text{Ce}(\text{NO}_3)_3$ ,  $\text{FeCl}_3$ ,  $\text{Fe}(\text{NO}_3)_3$ ,  $\text{FeSO}_4$  as the initiating material to synthesize the host-guest nano-composite materials by means of ion exchange, which are  $\text{TiO}_2$ ,  $\text{ZnO}$ ,  $\text{CeO}_2$ ,  $\text{Fe}_2\text{O}_3$  metal oxide nano-cluster and the molecular sieve ~~compound, the~~ compound. The product is used as the ultraviolet absorption agent to obtain the UV-resistant materials. material.

This method ~~includes~~ include following steps: dissolving the initiating material in the water, adding the molecular sieve, stirring at room temperature ~~temperatue~~ for 3-12 hours, filtrating, washing, and torrefying at 400-600°C for 4-24 hours.

Alternatively, dissolving the initiating material in the water, adding low-silicon molecular sieve, resting for 1 hours, filtrating, washing and drying at 80°C, and torrefying for at 500°C 12 hours.

The second preparation method uses ~~use~~ butyl titanate as the initiating material to synthesize host-guest nano-composite materials of TiO<sub>2</sub> cluster within a molecular ~~molecular~~ sieve compound by means of hydrolytic ~~reaction, the~~ reaction. The product is used as the ultraviolet absorption agent to obtain ~~the~~ UV-resistant materials. ~~material~~.

This method include following steps: mixing butyl titanate with high-silicon molecular sieve in non-polar ~~solvent~~, solvent with inert gas shielding, refluxing and agitating at 50-100°C for 4-48 hours, washing the product ~~by~~ with an alcohol type solvent, drying at 60-100°C, and torrefying for 4-24 hours at 400-600°C.

The ~~Present~~ present invention further provides ~~the use~~ uses of the UV-resistant ~~material~~ materials In cosmetics, coatings, rubber, ~~coatings, Rubber~~ and plastics industries. ~~industry~~.

## Embodiment

The present invention will be further described with reference to ~~expatiated~~ ~~with the following examples, but~~ non-limiting examples to which the invention is not to be considered limited, ~~to the examples given herein~~.

## Example 1

Assembling of X zeolite and ZnO.

1) ~~Weighing out~~ 10.00g of  $\text{Zn}(\text{NO}_3)_2$  was weighted out and dissolved dissolving it in 40 ml deionized water;

2) ~~Weighing out~~ 2.00g of X zeolite, ~~mixing with~~ zeolite was weighted out and mixed in the above solution, while maintaining the PH ~~equal to~~ pH at 4~5;

3) ~~Electromagnetic stirring~~ The mixture was electromagnetically stirred stirring for 1 ~~hour~~ hours at 40~50°C;

4) ~~Resting~~ After resting a moment, ~~pouring discarding~~ the supernatant liquor was poured off and discarded after delamination, ~~weighing out and~~ 10.00g of  $\text{Zn}(\text{NO}_3)_2$ ,  $\text{Zn}(\text{NO}_3)_2$  was weighted out and dissolved dissolving it in 40ml water, followed by electromagnetic stirring for 1 ~~hour~~ hours;

5) ~~Repeating the step~~ Step 4 for was repeated three times, followed by filtrating the solution in a by buchner funnel ~~in~~ the last time, repetitive washing by deionized water was performed to remove the impurity ions ~~ion~~ in the solution and  $\text{Zn}^{2+}$  out of the framework of the zeolite molecular sieve, then placing the resulting product was placed it in an oven and dried ~~oven, drying~~ for about 30 minutes at 60°C;

6) ~~Triturating the~~ The obtained product was triturated in an agate mortar for 10~15 minutes, then ~~placing it~~ placed in a 30ml firepot, and torrefied ~~torrefying~~ for 6 hours ~~by in a~~ muffle furnace at 550°C;

7) ~~Taking~~ The powdered product was taken out the firepot and triturated firepot, ~~tritulating the powder form~~ for 10~15 ~~minutes~~, minutes by replacing it into the muffle ~~furnace~~, furnace and torrefying for 6 hours under the same condition to obtain the product H-X-ZnO powder form.



## Example 2

### Assembling of Y zeolite and ZnO.

1) ~~Weighing out~~ 10.00g of  $\text{Zn}(\text{NO}_3)_2$  was weighted out and dissolved dissolving it in 40 ml deionized water;

2) ~~Weighing out~~ 2.00g of Y zeolite, ~~mixing with~~ zeolite was weighted out and mixed in the above solution, ~~maintaining the PH equal to~~ solution which was maintained at a pH of 4~5;

3) ~~Electromagnetic stirring~~ The solution was subjected to electromagnetic stirring for 1 ~~hour~~ hours at 40~50°C;

4) ~~Resting a moment, discarding~~ After resting, the supernatant liquor was discarded after delamination, and weighing out 10.00g of  $\text{Zn}(\text{NO}_3)_2$ ,  $\text{Zn}(\text{NO}_3)_2$  was weighted out and dissolved dissolving it in 40ml water, water and subjected to electromagnetic stirring for 1 ~~hour;~~ hours;

5) ~~Repeating the step~~ Step 4 was repeated for three times, filtrating times and then the solution was filtered in a by buchner funnel in the last time, time followed by repetitive scrubbing by deionized water to remove the impurity ions ion in the solution and  $\text{Zn}^{2+}$  out of the framework of the zeolite molecular sieve, then placing it in an oven, the resulting product was placed in an oven and dried drying for about 30 minutes at 60°C;

6) ~~Triturating the~~ The obtained product was triturated in an agate mortar for 10~15 minutes, then placing it placed in a 30ml firepot and torrefied firepot, torrefying for 6 hours by in a muffle furnace at 550°C;

7) Taking The powdered produce was taken out the firepot, tritulating firepot and trituated the powder form for 10~15 ~~minutes,~~ minutes by replacing it into the muffle ~~furnace,~~ furnace and torrefying for 6 hours under the same

condition to obtain the product H-Y-ZnO powder form.

### Example 3

Assembling of A zeolite and ZnO.

1) ~~Weighing out~~ 10.00g of  $\text{Zn}(\text{NO}_3)_2$  was weighted out and dissolving it  
dissolved in 40 ml deionized water;

2) ~~Weighing out of~~ 2.00g zeolite, mixing zeolite was weighted out and mixed  
with the above solution, ~~maintaining the PH equal to~~ solution which was  
maintained at a pH of 4~5;

3) ~~Electromagnetic stirring~~ The solution was subjected to electromagnetic  
stirring for 1 hours hour at 40~50°C;

4) ~~Resting a moment, discarding~~ After resting, the supernatant liquor was  
discarded after delamination, ~~weighing out and~~ 10.00g of  $\text{Zn}(\text{NO}_3)_2$ , ~~dissolving it~~  
 $\text{Zn}(\text{NO}_3)_2$  was weighted out and dissolved in 40ml water, water and subjected to  
electromagnetic stirring for 1 hours;

5) ~~Repeating the step~~ Step 4 was repeated for three times and then the  
solution was filtered in a times, ~~filtrating the solution by~~ buchner funnel in the last  
~~time,~~ time followed by repetitive washing by in deionized water to remove the  
impurity ~~ion~~ ions in the solution and  $\text{Zn}^{2+}$  out of the framework of the zeolite  
molecular sieve, ~~then placing it in an oven, drying~~ the resulting product was placed  
in an oven and dried for about 30 minutes at 60°C;

6) ~~Triturating the~~ The obtained product was triturated in an agate mortar for  
10~15 minutes, then ~~placing it~~ placed in a 30ml ~~firepot, torrefying~~ firepot and  
torrefied for 6 hours ~~by in~~ a muffle furnace at 550°C;

7) Taking The powdered produce was taken out of the firepot, triturating the

~~powder form~~ and triturated for 10~15 minutes, ~~replacing it~~ then replaced into the muffle furnace, ~~torrefying furnace and torrefied~~ for 6 hours under the same condition to obtain the product H-A-ZnO powder form.

#### Example 4

Assembling of STI zeolite and ZnO.

1) ~~Weighing out 10.00g of Zn(NO<sub>3</sub>)<sub>2</sub>~~ was weighted out and ~~dissolving it~~ dissolved in 40 ml deionized water;

2) ~~Weighing out 2.00g of STI zeolite, mixing with zeolite and mixed into the above solution, maintaining the PH equal to solution and maintained at a pH of 4~5;~~

3) ~~Electromagnetic~~ The solution was subjected to electromagnetic stirring for 1 hours hour at 40~50°C;

4) ~~Resting a moment, discarding~~ After resting, the supernatant liquor was discarded after delamination, ~~weighing out and~~ 10.00g of Zn(NO<sub>3</sub>)<sub>2</sub>, ~~dissolving it~~ Zn(NO<sub>3</sub>)<sub>2</sub> was weighted out and dissolved in 40ml water, water and subjected to electromagnetic stirring for 1 hour; hours;

5) ~~Repeating the step~~ Step 4 was repeated for three times and then the solution was filtered in a times, ~~filtrating the solution by buchner funnel in the last time,~~ time followed by repetitive washing by in deionized water to remove the impurity ions ion in the solution and Zn<sup>2+</sup> out of the framework of the zeolite molecular sieve, ~~then placing it in the heating oven, drying~~ the resulting product was placed in an oven and dried for about 30 minutes at 60°C;

6) ~~Triturating the~~ The obtained product was triturated in an agate mortar for 10~15 minutes, then ~~placing it~~ placed in a 30ml firepot, ~~torrefying firepot and~~

torrefied for 6 hours ~~by in a~~ muffle furnace at 550°C;

7) Taking ~~The powdered produce was taken out of the firepot, triturating the powder from firepot and triturated for 10~15 minutes, replacing it minutes then replaced into the muffle furnace, torrefying furnace and torrefied for 6 hours under the same condition to obtain the product H-STI-ZnO powder form.~~

#### Example 5

Assembling of ZSM-5 zeolite and ZnO.

1) ~~Weighing out 10.00g of  $\text{Zn}(\text{NO}_3)_2$  was weighted out and dissolving it dissolved in 40 ml deionized water;~~

2) ~~Weighing out 2.00g of ZSM-5 zeolite, mixing with zeolite and mixed into the above solution, maintaining the PH equal to solution and maintained at a pH of 4~5;~~

3) ~~Electromagnetic~~ The solution was subjected to electromagnetic stirring for 1 hour hours at 40~50°C;

4) ~~Resting a moment, discarding~~ After resting, the supernatant liquor was discarded after delamination, ~~weighing out and 10.00g of  $\text{Zn}(\text{NO}_3)_2$ , dissolving it  $\text{Zn}(\text{NO}_3)_2$  was dissolved in 40ml water, water and subjected to electromagnetic stirring for 1 hour;~~ hours;

5) Repeating the step Step 4 was repeated for three times and then the solution was filtered in a times, filtrating the solution by buchner funnel in the last time, time followed by repetitive washing by in deionized water to remove the impurity ions ~~ion~~ in the solution and  $\text{Zn}^{2+}$  out of framework of the zeolite molecular sieve, ~~then placing it in an oven, drying the resulting product was placed in an oven and dried~~ for about 30 minutes at 60°C;

6) ~~Triturating the~~ The obtained product was triturated in an agate mortar for 10~15 minutes, then ~~placing it~~ placed in a 30ml firepot, ~~torrefying~~ firepot and torrefied for 6 hours by in a muffle furnace at 550°C;

7) ~~Taking~~ The powdered produce was taken out on the firepot, ~~tritulating the powder form~~ firepot and triturated for 10~15 minutes, ~~replacing it~~ minutes then replaced into the muffle furnace, ~~torrefying~~ furnace and torrefied for 6 hours under the same condition to obtain the product ZSM-5-ZnO powder form.

#### Example 6

Assembling of MCM-41 zeolite and ZnO.

1) ~~Weighing out~~ 10.00g of  $\text{Zn}(\text{NO}_3)_2$  was weighted out and ~~dissolving it~~ dissolved in 40 ml deionized water;

2) ~~Weighing out~~ 2.00g of MCM-41 zeolite, ~~mixing with~~ zeolite and mixed into the above solution, ~~maintaining the PH equal to~~ solution and maintained at a pH of 4~5;

3) ~~Electromagnetic~~ The solution was subjected to electromagnetic stirring for 1 ~~hour~~ hours at 40~50°C;

4) ~~Resting a moment, discarding~~ After resting, the supernatant liquor was discarded after delamination, ~~weighing out and~~ 10.00g of  $\text{Zn}(\text{NO}_3)_2$ , ~~dissolving it~~  $\text{Zn}(\text{NO}_3)_2$  was weighted out and dissolved in 40ml water, water and subjected to electromagnetic stirring for 1 ~~hour;~~ hours;

5) ~~Repeating the step~~ Step 4 was repeated for three times and then the solution was filtered in a times, ~~filtrating the solution by~~ buchner funnel in the last ~~time,~~ time followed by repetitive washing by in deionized water to remove the impurity ions ~~ion~~ in the solution and  $\text{Zn}^{2+}$  out of the framework of the zeolite

molecular sieve, ~~then placing it in the heating oven, drying the resulting product~~  
was placed in an oven and dried for about 30 minutes at 60°C;

6) ~~Triturating the~~ The obtained product was triturated in an agate mortar for 10~15 minutes, ~~then placing it~~ minutes then placed in a 30ml firepot, ~~torrefying~~  
firepot and torrefied for 6 hours ~~by~~ in a muffle furnace at 550°C;

7) ~~Taking~~ The powdered produce was taken out the firepot, ~~tritulating the~~  
powder form firepot and triturated for 10~15 minutes, ~~replacing it~~ minutes then  
replaced into the muffle furnace, ~~torrefying~~ furnace and torrefied for 6 hours under  
the same condition to obtain the product H-MCM-ZnO powder form.

#### Example 7

Assembling of X zeolite and Fe<sub>2</sub>O<sub>3</sub>.

1) ~~Weighing out~~ 10.00g of FeSO<sub>4</sub> was weighted out and ~~dissolving it~~ dissolved  
in 40 ml deionized water;

2) ~~Weighing out~~ 2.00g of X zeolite, ~~mixing with~~ zeolite was weighted out and  
mixed into the above solution, ~~maintaining the PH equal to~~ solution and maintained  
at a pH of 4~5;

3) ~~Electromagnetic~~ The solution was subjected to electromagnetic stirring for 1  
~~hours~~ hour at 40~50°C;

4) ~~Resting a moment, discarding~~ After resting, the supernatant liquor was  
discarded after delamination, ~~weighing out~~ 10.00g of FeSO<sub>4</sub>, ~~dissolving it~~ FeSO<sub>4</sub>  
was weighted out and dissolved in 40ml water, water and subjected to  
electromagnetic stirring for 1 hour; ~~hours~~;

5) ~~Repeating the step~~ Step 4 was repeated for three times and then the  
solution was filtered in a ~~times, filtrating the solution by~~ buchner funnel in the last

~~time, time followed by~~ repetitive washing ~~by in~~ deionized water to remove the impurity ~~ions in~~ in the solution and  $\text{Fe}^{2+}$  out of the framework of the zeolite molecular sieve, ~~then placing it in an oven, drying the resulting product was placed~~ in an oven and dried for about 30 minutes at  $60^{\circ}\text{C}$ ;

6) ~~Triturating the~~ The obtained product was triturated in an agate mortar for 10~15 minutes, then ~~placing it~~ placed in a 30ml firepot, ~~torrefying firepot and~~ torrefied for 6 hours ~~by in~~ a muffle furnace at  $550^{\circ}\text{C}$ ;

7) ~~Taking~~ The powdered produce was taken out the firepot, ~~tritulating the powder form firepot and triturated~~ for 10~15 minutes, ~~replacing it minutes then~~ replaced into the muffle furnace, ~~torrefying furnace and torrefied~~ for 6 hours under the same condition to obtain the product  $\text{H-X-Fe}_2\text{O}_3$  powder form.

#### Example 8

Assembling of Y zeolite and  $\text{Fe}_2\text{O}_3$ .

1) ~~Weighing out 10.00g of  $\text{FeSO}_4$  was weighted out and dissolved~~ dissolving it in 40 ml deionized water;

2) ~~Weighing out 2.00g of Y zeolite, mixing with zeolite and mixed into the above solution, maintaining the PH equal to~~ solution and maintained at a pH of 4~5;

3) ~~Electromagnetic~~ The solution was subjected to electromagnetic stirring for 1 ~~hour~~ hours at  $40\sim 50^{\circ}\text{C}$ ;

4) ~~Resting a moment, discarding~~ After resting, the supernatant liquor was discarded after lamintion, ~~weighing out and 10.00g of  $\text{FeSO}_4$ , dissolving it  $\text{FeSO}_4$  was weighted out and dissolved~~ in 40ml water, water and subjected to electromagnetic stirring for 1 hours hours;

5) ~~Repeating the step~~ Step 4 was repeated for three times and then the

~~solution was filtered in a times, filtrating the solution by~~ buchner funnel in the last time, ~~time followed by~~ repetitive washing by ~~in~~ deionized water to remove the impurity ~~ions~~ ~~ion~~ in the solution, ~~then placing it in an oven, drying the resulting product was placed in an oven and dried for about 30 minutes at 60°C;~~

6) ~~Triturating the~~ The obtained product was triturated in an agate mortar for 10~15 minutes, then ~~placing it~~ placed in a 30ml firepot, ~~torrefying firepot and torrefied for 6 hours by in a muffle furnace at 550°C;~~

7) ~~Taking~~ The powdered produce was taken out the firepot and trituated firepot, ~~tritulating the powder form for 10~15 minutes, replacing it minutes then replaced into the muffle furnace, torrefying furnace and torrefied for 6 hours under the same condition to obtain the product H-Y-Fe<sub>2</sub>O<sub>3</sub> powder form.~~

#### Example 9

Assembling of A zeolite and Fe<sub>2</sub>O<sub>3</sub>.

1) ~~Weighing out 10.00g of FeSO<sub>4</sub> was weighted out and dissolved dissolving it in 40 ml deionized water;~~

2) ~~Weighing out 2.00g of A zeolite, mixing with zeolite was weighted out and mixed in the above solution, maintaining the PH equal to solution and maintained at a pH of 4~5;~~

3) ~~Electromagnetic~~ The solution was subjected to electromagnetic stirring for 1 hour ~~hours~~ at 40~50°C;

4) ~~Resting a moment, discarding~~ After resting, the supernatant liquor was discarded after lamintion, ~~weighing out 10.00g of FeSO<sub>4</sub>, dissolving it FeSO<sub>4</sub> was weighted out and dissolved in 40ml water, water and subjected to electromagnetic stirring for 1 hour;~~ ~~hours;~~



~~5) Repeating the step Step 4 was repeated~~ for three times and then the solution was filtered in a times, filtrating the solution by buchner funnel in the last time, time followed by repetitive washing by in deionized water to remove the impurity ions ~~ion~~ in the solution, ~~then placing it in an oven, drying the resulting product was placed in an oven and dried~~ for about 30 minutes at 60°C;

6) ~~Triturating the~~ The obtained product was triturated in an agate mortar for 10~15 minutes, then ~~placing it~~ placed in a 30ml firepot, ~~torrefying firepot and~~ torrefied for 6 hours ~~by in a muffle furnace at 550°C;~~

7) ~~Taking~~ The powdered produce was taken out the firepot, ~~tritulating the powder form firepot and triturated~~ for 10~15 minutes, ~~replacing it minutes then replaced~~ into the muffle furnace, ~~torrefying furnace and torrefied~~ for 6 hours under the same condition to obtain the product H-A-Fe<sub>2</sub>O<sub>3</sub> powder form.

#### Example 10

Assembling of STI zeolite and Fe<sub>2</sub>O<sub>3</sub>.

1) ~~Weighing out 10.00g of FeSO<sub>4</sub> was weighted out and dissolved~~ dissolving it in 40 ml deionized water;

2) ~~Weighing out 2.00g of STI zeolite, mixing with zeolite was weighted out and mixed into the above solution, maintaining the PH equal to solution and maintained~~ at a pH of 4~5;

3) ~~Electromagnetic~~ The solution was subjected to electromagnetic stirring for 1 ~~hour~~ hours at 40~50°C;

4) ~~Resting a moment, discarding~~ After resting, the supernatant liquor was discarded after lamintion, ~~weighing out 10.00g of FeSO<sub>4</sub> again, dissolving it FeSO<sub>4</sub> was weighted out and dissolved~~ in 40ml ~~water,~~ water and subjected to

electromagnetic stirring for 1 ~~hour~~ hours;

5) ~~Repeating the step Step 4 was repeated~~ for three times and then the solution was filtered in a times, ~~filtrating the solution by~~ buchner funnel in the last ~~time~~, time followed by repetitive washing ~~by in~~ deionized water to remove the impurity ions ~~ion~~ in the solution, ~~then placing it in an oven~~, drying the resulting product was placed in an oven and dried for about 30 minutes at 60°C;

6) ~~Triturating the~~ The obtained product was triturated in an agate mortar for 10~15 minutes, then ~~placing it~~ placed in a 30ml firepot, ~~torrefying~~ firepot and torrefied for 6 hours ~~by in a~~ muffle furnace at 550°C;

7) ~~Taking~~ The powdered produce was taken out the firepot, ~~tritulating the powder form~~ firepot and triturated for 10~15 minutes, ~~replacing it~~ minutes then replaced into the muffle furnace, ~~torrefying~~ furnace and torrefied for 6 hours under the same condition to obtain the product H-STI-Fe<sub>2</sub>O<sub>3</sub> powder form.

#### Example 11

Assembling of MCM-41 zeolite and Fe<sub>2</sub>O<sub>3</sub>.

1) ~~Weighing out~~ 10.00g of FeSO<sub>4</sub> was weighted out and dissolved ~~dissolving it~~ in 40 ml deionized water;

2) ~~Weighing out~~ 2.00g of MCM-41 zeolite, ~~mixing with~~ zeolite and mixed into the above solution, ~~maintaining the PH equal to~~ solution and maintained at a pH of 4~5;

3) ~~Electromagnetic~~ The solution was subjected to electromagnetic stirring for 1 ~~hour~~ hours at 40~50°C;

4) ~~Resting a moment, discarding~~ After resting, the supernatant liquor was discarded after lamintion, ~~weighing out and~~ 10.00g of FeSO<sub>4</sub>, ~~dissolving it~~ FeSO<sub>4</sub>

was weighted out and dissolved in 40ml water, water and subjected to  
electromagnetic stirring for 1 hour; hours;

5) ~~Repeating the step~~ Step 4 was repeated for three times and then the  
solution was filtered in a times, filtrating the solution by buchner funnel in the last  
time, repetitive washing ~~by in~~ deionized water to remove the impurity ions ~~ion~~ in  
the solution, ~~then placing it in an oven, drying~~ for about 30 minutes at 60°C;

6) ~~Triturating the~~ The obtained product was triturated in an agate mortar for  
10~15 minutes, then ~~placing it~~ placed in a 30ml firepot, ~~torrefying~~ firepot and  
torrefied for 6 hours ~~by in a~~ muffle furnace at 550°C;

7) ~~Taking~~ The powdered produce was taken out the firepot, ~~tritulating the~~  
~~powder form~~ firepot and triturated for 10~15 ~~minutes, replacing it~~ minutes then  
replaced into the muffle furnace, ~~torrefying~~ furnace and torrefied for 6 hours under  
the same condition to obtain the product H-MCM-Fe<sub>2</sub>O<sub>3</sub> powder form.

## Example 12

Assembling of CeO<sub>2</sub> nano-cluster in X, Y, A, ZSM-5, STI, and MCM-41 zeolite.

1) ~~Weighting out~~ 10.00g of Ce(NO<sub>3</sub>)<sub>2</sub> was weighted out and dissolved ~~dissolving~~  
it in 40 ml deionized water;

2) ~~Weighting out~~ 2.00g of zeolite (any one of X, Y, A, ZSM-5, STI, and MCM-41)  
was weighted out and mixed into ~~), mixing with the above solution, maintaining the~~  
~~PH equal to~~ solution and maintained at a pH of 4~5;

3) ~~Electromagnetic~~ The solution was subject to electromagnetic stirring for 1  
hours ~~hours~~ at 40~50°C;

4) ~~Resting a moment, djiscarding~~ After resting, the supernatant liquor was  
discarded after delamination, ~~weighing out and~~ 10.00g of Ce(NO<sub>3</sub>)<sub>2</sub>, ~~dissolving it~~

Ce(NO<sub>3</sub>)<sub>2</sub> was weighted out and dissolved in 40ml water, water and subjected to  
electromagnetic stirring for 1 hour; hours;

5) ~~Repeating the step~~ Step 4 was repeated for three times and then the  
solution was filtered in a times, filtrating the solution by buchner funnel in last time,  
repetitive washing by in deionized water to remove the impurity ions ~~ion~~ in the  
solution, ~~then placing it in an oven, drying~~ the resulting product was placed in an  
oven and dried for about 30 minutes at 60°C;

6) ~~Triturating the~~ The obtained product was triturated in an agate mortar for  
10~15 minutes, then ~~placing it~~ placed in a 30ml ~~firepot, torrefying~~ firepot and  
torrefied for 6 hours ~~by in a~~ muffle furnace at 550°C;

7) ~~Taking~~ The powdered produce was taken out the ~~firepot, triturating the~~  
~~powder form~~ firepot and triturates for 10~15 minutes, ~~replacing it~~ minutes then  
replaced into the muffle ~~furnace, torrefying~~ furnace and torrefied for 6 hours under  
the same condition to obtain the product.

### Example 13

Assembling of TiO<sub>2</sub> nano-cluster in X, Y, A, ZSM-5, STI, and MCM-41 zeolite.

1) ~~Weighing out~~ 10.00g of TiCl<sub>3</sub> was weighted out and dissolved ~~dissolving it~~  
in 40 ml deionized water;

2) ~~Weighing out~~ 2.00g of zeolite (any one of X, Y, A, ZSM-5, STI, and MCM-41)  
was weighted out and mixed into ~~), mixing with the above solution, maintaining the~~  
~~PH equal to~~ solution and maintained at a pH of 4~5;

3) ~~Resting~~ The solution rested for 1 hour hours at room temperature;

4) ~~Filtrating,~~ The rested solution was filtered and the filtrate was repetitively  
washed in ~~repetitive washing by~~ deionized water to remove the impurity ions ~~ion~~ in

the solution, then ~~placing it~~ placed in an ~~oven, drying oven and dried~~ for about 30 minutes at 60°C;

5) ~~Triturating the~~ The obtained product was triturated in an agate mortar for 10~15 minutes, then ~~placing it~~ placed in a 30ml ~~firepot, torrefying firepot and~~ torrefied for 6 hours ~~by~~ in muffle furnace at 550°C;

7) ~~Taking~~ The powdered produce was taken out the ~~firepot, triturating the~~ powder form firepot and triturated for 10~5 minutes, ~~replacing it~~ minutes then replaced into the muffle ~~furnace, torrefying furnace and~~ torrefied for 6 hours under the same condition to obtain the product.

#### Example 14

The preparation of acrylic acid-azyl varnish:

	wt%
Acrylic resin (70% solid content )	52.2
amino resin (70% solid content)	22.3
Tinnvin 292	0.5
Tinnvin 1130	0.8
drainning silicea (10%)	5.0
butyl acetate	5.0
dimethylbenzene	10.0
ethylene glycol monobutyl ether acetate	2.7
n-butyl alcohol	1.5

#### Synthetic method

1 ~~Weighing mainly resin~~ Resin such as acrylic resin and amino resin were precisely

~~weighted out and placed precisely, placing them~~ into clean and separated vessels;

2 ~~First, adding A~~ high boiling point solvent such as butyl acetate and ethylene glycol butyl ether acetate was added into resin to make it be ~~disluted~~, diluted while gradually ~~increase~~ increasing the stirring rate;

3 ~~Weighing out required~~ The Tinuvin 272 was precisely weighted out and diluted with precisely, disluting it by a few butyl acetate or dimethylbenzene to make it be dispersed;

4 ~~Weighing out different~~ Different kinds of auxiliary agents such as draining drainning silica and diluting them were weighted out and diluted by the same method and then adding ~~them~~ into the vessel;

5 ~~Adding the left solvents~~ The remaining solvent were added into the vessel, dispersing vessel and the contents were dispersed under high speed (2000~3000rpm) for 20~30mins.

#### Example 15

The preparation of the sun block:

	wt%
A: refining water	50
polyoxyalkylene	12
polyacrylic acid solution	2
sodium lauryl sulfate	0.5
caisson	0.1
B: isopropyl myristate	10
isopropyl palmitate	10
acetylated lanolin	5

t-butyl hydroxyl anisole	0.05
C: nano-composite UV-resistant agent	8
mica powder	1
D: fragrance essence	0.85

Synthetic method:

~~Mixing and stirring A, Components A and B respectively mixed and stirred to make~~  
~~cause them be resolved, emulsifying the components A, B, C, and C were~~  
~~emulsified and component then adding E was added thereto and the resultant~~  
~~mixture was rested into the former, resting for 24 hours .~~